Real-Time Vertical Temperature, and Velocity Profiles from a Wave Glider

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LONG-TERM GOALS

The long-term goal of this effort is to develop a system capable of active navigation/station keeping and able to measure profiles of temperature, conductivity and pressure in the upper part of the water column with an endurance of at least three months.

OBJECTIVES

The first objective of this project is to demonstrate that a wave glider fitted with an underwater winch can operate for at least two months without service and collect TD profiles in the upper 100 m of the water column. The second objective is to develop an electronic control system that will operate the winch acccording to pre-set environmental conditions and will download and transmit the TD data through Iridium.

APPROACH

The first phase of the project was the procurement of a wave glider with an ADCP and the design and procurement of the underwater winch system. A first set of tests was then designed to demonstrate the navigation and station keeping capabilities of the wave glider with the addition of the winch system. The second set of tests was designed to demonstrate the winch operation at sea with a mock-up TD probe. The third set of tests was designed to demonstrate the operation of the full system with an operational TD probe in controlled conditions off the SIO pier, to test also the data link between the dry payload developed by SIO to control the winch and communicate with the TD. The final test will be the navigation of the fully working system along the coast of California.

WORK COMPLETED

The first phase of the project is concluded. By April of 2013 the wave glider, ADCP and winch systems were in receipt at SIO.

Following field trials with the first-generation underwater winch (UWW), SIO provided MacArtney with a number of field notes and recommended changes for the system. These notes included WG

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navigational capabilities with the UWW attached, ruggedness of the UWW, level-wind synchronization following multiple casts, as well as notes on the spurious stalls incurred due to the mechanical braking system.

The second generation UWW was delivered by MacArtney in May, 2014 and was deployed in June 2014 during Field Operations 4. As a precaution due to the added power consumption of the new brake, winching speeds were reduced by 20% to compensate. In total, the UWW profiled for 3.5 hours with no issue. During this trial, the target depth of 100 meters was reached and verified by the SBE39 readings. The re-gearing of the level-wind showed good synchronization with the cable on the spool throughout testing.

Despite performing well in the field, quality control issues were found on the delivered winch. During hardware checkout prior to Field Operations 4, incorrect length bolts were found sealing the rubber membrane of the motor housing. Following deployment for Field Operations 4, significant corrosion was found on the UWW housing.This corrosion was something not found on the first generation winch following Field Operations 2 and 3.

As a result of these issues, the second-generation UWW was shipped back to MacArtney immediately following Field Operations 4, along with the first-generation UWW for refurbishment to second-generation specifications. Following a complete tear down by MacArtney, it was determined that the corrosion issue was caused by pit-corrosion on the winch drum shaft. This was remedied by fabricating a replacement shaft. The two refurbished UWW's are expected to be returned to SIO in November 2014.

Two generations of host microcontrollers have been developed for the WG UWW. The first-generation controller, Ghostfish, is a miniaturized microcontroller, with a 20-pin Input/output (I/O) bus capable of utilizing add-on expansion modules. The second-generation, Halibut, host microcontroller incorporates the various Ghostfish expansion modules onto a single printed circuit board (PCB) layout.

A power system was developed for the UWW to limit back electromotive force (back-EMF) induced by current surges from the UWW's motor. Majority of the power system is housed on the WG Sub in a long cylindrical water-tight enclosure to limit negative drag effects while piloting.

A web portal has been designed as a WGMS replacement application. Because of the custom sensor suite, the default piloting application for the wave glider does not offer real-time diagnostic monitoring, and sensor management required for an UWW equipped WG. To address this, development of an in-house designed WGMS replacement has begun.

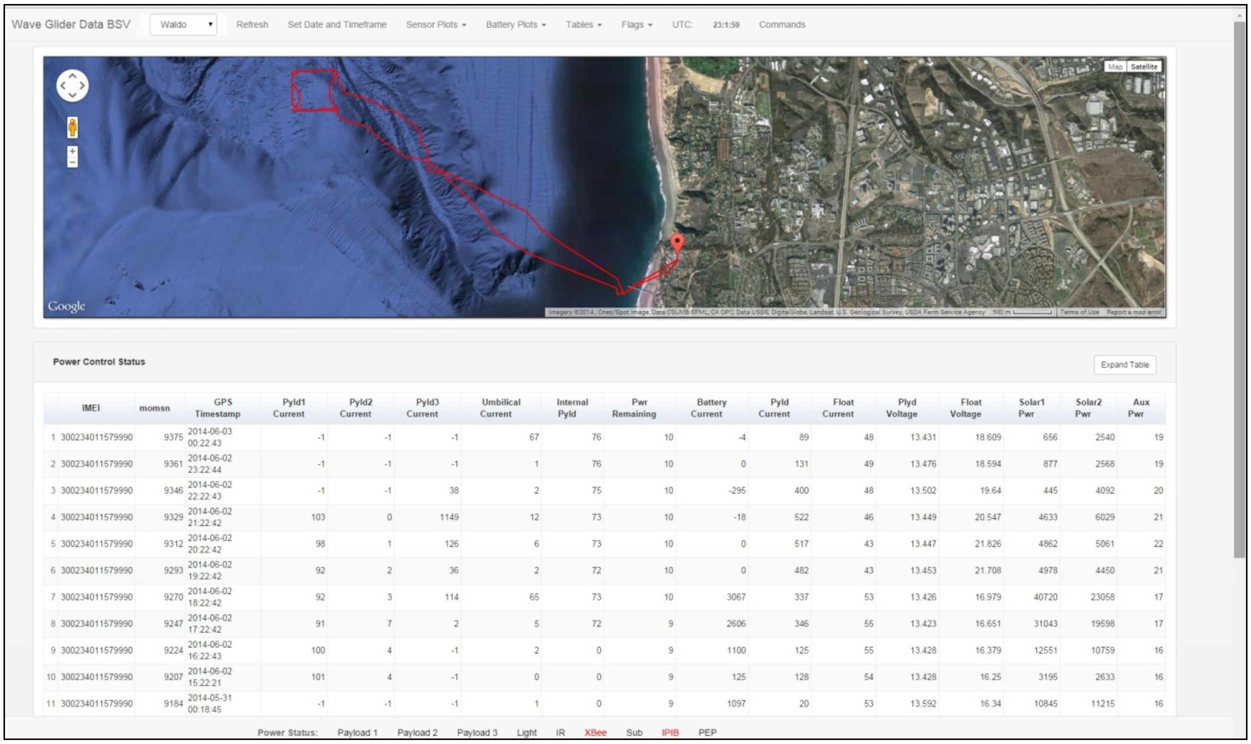

Figure 1: Wave Glider Management Software replacement on SIO webserver

Using the Iridium server developed and located at SIO, all WG transmitted SBD messages are decoded in real-time and made available for viewing through a password protected web application. This application reduces the complexity of WGMS while maintaining full functionality of basic piloting utilities and diagnostic information. Further, the WGMS replacement enables full processing and visualization of both the primary and the secondary Iridium SBD system found on the WG. These secondary Iridium sensors include the onboard Waves engine, RDI ADCP, and UWW payload diagnostics.

Currently, the web application is only read-only. Development is currently in progress for sending command packets to the Wave Glider via SBD protocol. WGMS is used for packet generation and transmission at current time.

IMPACT/APPLICATIONS

We plan to use the profiling wave glider in regions of the ocean that cannot be accessed with R/V.

PUBLICATIONS

None